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Antibiotic resistance of microorganisms in agricultural soils in Russia

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Abstract

© Published under licence by IOP Publishing Ltd. Antibiotics are medicines that are widely used in livestock production not only for the prevention and treatment of infectious diseases, but also for accelerating the growth of animals. The application of manure for fertilizing agricultural soils leads to the entry into the soil ecosystem not only of the antibiotics themselves, but also the resistance genes to them. In this study, 30 samples of arable soils were tested for the presence of the tet(X) gene, which encodes bacterial resistance to antibiotics of the tetracycline group. Using real-time PCR, it was found that 27 out of 30 soil samples contained tet(X). 52% of these samples were heavily contaminated, 34% had a medium level of contamination and 14% were slightly contaminated by the resistance gene tet(X).

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References

[1] Sarmah A, Meyer M and Boxall A 2006 A global perspective on the use, sales, exposure pathways, occurrence, fate and effects of veterinary antibiotics (VAs) in the environment Chemosphere 65 725-759

[2] Kemper N 2008 Veterinary antibiotics in the aquatic and terrestrial environment Ecol. Indic. 8 1-13

[3] Thiele-Bruhn S 2003 Pharmaceutical antibiotic compounds in soils - A review J. Plant Nutr. Soil Sci. 166 145-167

[4] Du L and Liu W. 2012 Occurrence, fate, and ecotoxicity of antibiotics in agro-ecosystems. A review Agron. Sustain. Dev. 32 309-327

[5] Jechalke S, Heuer H, Siemens J, Amelung W and Smalla K 2014 Fate and effects of veterinary antibiotics in soil Trends Microbiol. 22 536-545

[6] Caniça M, Manageiro V, Jones-Dias D, Clemente L, Gomes-Neves E, Poeta P, Dias E and Ferreira E 2015 Current perspectives on the dynamics of antibiotic resistance in different reservoirs Res. Microbiol. 166 594-600

[7] Halling-Sorensen B, Nielsen SN, Lanzky PF, Ingerslev F, Holten Lutzhoft HC and Jorgensen SE 1998 Occurence, fate and effects of pharmaceuticals substance in the environment - A review Chemosphere 36 357-393

[8] Thiele-Bruhn S and Beck IC 2005 Effects of sulfonamide and tetracycline antibiotics on soil microbial activity and microbial biomass Chemosphere 59 457-465

[9] Song L, Li L, Yang S, Lan J, He H, McElmurry SP and Zhao Y 2016 Sulfamethoxazole, tetracycline and oxytetracycline and related antibiotic resistance genes in a large-scale landfill, China Sci. Total Environ. 551-552 9-15

[10] Gao M, Song W, Zhou Q, Ma X and Chen X 2013 Interactive effect of oxytetracycline and lead on soil enzymatic activity and microbial biomass Environ. Toxicol. Pharmacol. 36 667-674

[11] Selvam A, Xu D, Zhao Z and Wong J 2012 Fate of tetracycline, sulfonamide and fluoroquinolone resistance genes and the changes in bacterial diversity during composting of swine manure Bioresour. Technol. 126 383-390

[12] Kotzerke A, Sharma S, Schauss K, Heuer H, Thiele-Bruhn S, Smalla K, Wilke BM and Schloter M 2008 Alterations in soil microbial activity and N-transformation processes due to sulfadiazine loads in pig-manure Environ. Pollut. 153 315-322

[13] Böhme L, Langer U and Böhme F 2005 Microbial biomass, enzyme activities and microbial community structure in two European long-term field experiments Agric. Ecosyst. Environ. 109 141-152

[14] Aydin S, Ince B and Ince O 2015 Development of antibiotic resistance genes in microbial communities during long-term operation of anaerobic reactors in the treatment of pharmaceutical wastewater Water Res. 83 337-344

[15] Tang X et al 2015 Effects of long-term manure applications on the occurrence of antibiotics and antibiotic resistance genes (ARGs) in paddy soils : Evidence from four fi eld experiments in south of China Soil Biol. Biochem. 90 179-187

[16] Alonso A, Sánchez P and Martínez JL 2001 Environmental selection of antibiotic resistance genes Env. Microbiol. 3 1-9

[17] Chee-Sanford JC, Mackie RI, Koike S, Krapac IG, Lin Y, Yannarell AC, Maxwell S and Aminov RI 2009 Fate and Transport of Antibiotic Residues and Antibiotic Resistance Genes J. Environ. Qual. 38 1086-1108

[18] Heuer H, Schmitt H and Smalla K 2011 Antibiotic resistance gene spread due to manure application on agricultural fields Curr. Opin. Microbiol. 14 236-243

[19] Fang H, Han Y, Yuanming Y, Xiong P and Yunlong Y 2014 Variations in dissipation rate, microbial function and antibiotic resistance due to repeated introductions of manure containing sulfadiazine and chlortetracycline to soil Chemosphere 96 51-56

[20] Wang F, Qiao M, Chen Z, Su J and Zhu Y. 2015 Antibiotic resistance genes in manure-amended soil and vegetables at harvest J. Hazard. Mater. 299 215-221

[21] ISO 14240-1:1997 1997 Soil quality-Determination of soil microbial biomass - Part 1: Substrate- induced respiration method

[22] ISO 14235:1998 1998 Soil quality-Determination of organic carbon by sulfochromic oxidation

[23] ISO 13320:2009 2009 Particle size analysis - Laser diffraction methods

[24] Zhang W, Huang M, Qi F, Sun P and Van Ginkel SW 2013 Effect of trace tetracycline concentrations on the structure of a microbial community and the development of tetracycline resistance genes in sequencing batch reactors Bioresour. Technol. 150 9-14

[25] Sharma VK, Johnson N, Cizmas L, Mcdonald TJ and Ki H 2016 A review of the influence of treatment strategies on antibiotic resistant bacteria and antibiotic resistance genes Chemosphere 150 702-714

[26] Yeom J, Yoon S and Kim C 2017 Quantification of residual antibiotics in cow manure being spread over agricultural land and assessment of their behavioral effects on antibiotic resistant bacteria Chemosphere 182 771-780

[27] Tien Y, Li B, Zhan T, Scott A, Murray R, Sabourin L, Marti R and Topp E 2017 Impact of dairy manure pre-application treatment on manure composition, soil dynamics of antibiotic resistance genes and abundance of antibiotic-resistance genes on vegetables at harvest Sci. Total Environ. 581-582 32-39

[28] Agersø Y and Jensen L 2002 The identification of a tetracycline resistance gene tet (M), on a Tn916-like transposon, in the Bacillus cereus group FEMS Microbiol. Lett 214 251-256

[29] Asai T, Kojima A, Harada K and Ishihara K 2005 Correlation between the Usage Volume of Veterinary Therapeutic Antimicrobials and Resistance in Escherichia coli Isolated from the Feces of Food-Producing Animals in Japan Jpn J. Infect. Dis. 58 369-372

[30] Srinivasan V, Nam H and Oliver SP 2008 Distribution of Tetracycline and Streptomycin Resistance Genes and Class 1 Integrons in Enterobacteriaceae Isolated from Dairy and Nondairy Farm Soils Microb Ecol. 55 184-193

[31] Wu N, Qiao M, Zhang B, Cheng WD and Zhu YG 2010 Abundance and diversity of tetracycline resistance genes in soils adjacent to representative swine feedlots in China Environ. Sci.Technol. 44 6933-6939

[32] Peng S, Feng Y, Wang Y, Guo X, Chu H and Lin X 2017 Prevalence of antibiotic resistance genes in soils after continually applied with different manure for 30 years J. Hazard. Mater. 340 16-25

[33] Zhao X, Wang J, Zhu L, Ge W and Wang J 2017 Environmental analysis of typical antibiotic-resistant bacteria and ARGs in farmland soil chronically fertilized with chicken manure Sci. Total Environ. 593-594 10-17

[34] Cheng W, Li J, Wu Y, Xu L, Su C, Qian Y, Zhu YG and Chen H 2016 Behavior of antibiotics and antibiotic resistance genes in eco-agricultural system: A case study J. Hazard. Mater. 304 18-25

[35] Danilova N, Galitskaya P and Selivanovskaya S 2016 Multiresistance of bacte-ria to veterinary antibiotics in dung and manure samples of farm animals Uchenye Zapiski Kazanskogo Universiteta. Seriya Estestvennye Nauk. 158 507-516